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ABSTRACT

The Presidential Awards for Excellence in Science and Mathematics Teaching were awarded for the first time in October 1983. This bulletin spotlights the two Oregon mathematics teachers who were nominated by the state for the national award. Sue McGraw and Fred Board are master teachers with unique, individual, and exceptional classroom teaching abilities. Both are accessible to students and responsive to their needs. Besides teaching and actively participating in professional organizations, they both volunteer many hours to mathematics education in Oregon. Both teachers continuously update their professional training. The national selection committee rated McGraw and Board uniformly highly, but chose McGraw to receive the award for Oregon. (MD)

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Excellence in Mathematics Teaching: Profiles of Two Oregon Teachers

Lois J. Rawers

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Preface

Mathematics instruction, like science instruction, has attracted considerable attention recently as studies reveal that U.S. students lag behind their counterparts in other countries in mathematics and science skills/knowledge and as panels and officials offer recommendations to improve school programs. October's Bulletin described one Oregon high school program that fulfills many of the recommendations to improve science instruction. This month we spotlight two Oregon teachers who deliver to their students the high quality mathematics instruction recommended in recent reports.

This Bulletin was written by Lois Rawers, OSSC graduate research assistant.

Philip K. Piele
Executive Secretary

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Introduction

Sue McGraw of Lake Oswego High School in Lake Oswego and Fred Board of Westridge Middle School in Oakridge, were Oregon's two mathematics teacher finalists for this year's Presidential Awards for Excellence in Science and Mathematics Teaching. Board and McGraw were chosen through a rigorous nomination-application process coordinated across the state by Don Fineran, mathematics education specialist with the Oregon Department of Education. The National Presidential Awards selection committee subsequently recommended Sue McGraw as Oregon's Presidential Award winner.

Fineran stresses the extreme difficulty that Oregon selection committees experienced in narrowing their recommendations down to only two finalists. This should be encouraging today when we hear so much criticism of mathematics instruction in public schools. True, there may not be enough qualified mathematics teachers to go around, but there are many competent, successful ones out there in the classrooms. The Presidential Awards and this Bulletin are but two attempts to recognize the many able mathematics teachers in Oregon public schools.

The Presidential Awards for Excellence

This past summer the National Science Foundation announced the Presidential Awards for Excellence in Science and Mathematics Teaching to be given for the first time in October to 104 outstanding science and mathematics teachers from junior and senior high schools throughout the United States. In addition to the recognition these teachers would receive for their excellence in teaching, each award winning teacher's school would get a $5,000 grant to supplement its budget for mathematics or science teaching. The purpose of the awards program was to improve the image and status of teaching in these two areas by enhancing the visibility of and incentives to mathematics and science teachers.

The National Council of Teachers of Mathematics (NCTM) handled nomination and selection of finalists among mathematics teachers. State awards directors were charged with organizing and coordinating thorough screening processes to yield two finalists from each of the fifty states as well as from the District of Columbia and Puerto Rico. Don Fineran orchestrated the two-stage selection procedure that named McGraw and Board as Oregon's finalists for the mathematics teaching award. In the initial phase, Oregon Council of Teachers of Mathematics (OCTM) current and past officers considered some 45 to 50 teachers from around the state, teachers that they themselves named and ones that had been suggested by teachers' and administrators' organizations. Bill Burger, OCTM treasurer and professor of mathematics at Oregon State University, explains that this large number of potential nominees is indicative of the large number of dynamic leaders in mathematics education in this

state.

The nominations team considered each teacher in light of eligibility standards and nomination criteria set by the National Presidential Awards for Excellence criteria committee. (These standards are reproduced in Appendix A.) The OCTM panel produced a slate of fifteen Oregon nominees in mathematics. In addition to Fred Board and Sue McGraw, the slate included:

Mike Bolduan
Catlin Gabel High School
Portland

Linda Denny
Sunset High School
Beaverton

Alice Kaseberg
South Eugene High School
Eugene

Scott McFadden
Sheldon High School
Eugene

Donna McNair
Medford Mid High School
Medford

Katie Miller
La Grande High School
La Grande

Earl Phillips
Columbia High School
Troutdale

Wally Rogelstad
Rex Putnam High School
Milwaukie

Larry Sleeman
Philomath Middle School
Philomath

James V. Stewart
Mazama High School
Klamath Falls

Tom Swansom
Jefferson High School
Portland

Joanne Wilkie
Tubman Middle School
Portland

Jim Young
Clackamas High School
Milwaukie

These fifteen teachers were asked to detail their background and experience, to answer three questions in depth, and to submit letters of support and recommendation. Appendix B shows the specific information they needed to submit in order to be considered for the award.

Fineran assembled a five-member selection committee to consider the

ten nominees who completed the awards application process. (Fineran explains that each of the five nominees who did not apply had sound, even noble, reasons for not doing so.) Members of the Oregon Selection Committee were: Rosie Allen, teacher, North Albany Middle School, Albany; Jack Gallagher, teacher, Madras High School, Madras; Judy Johnson, teacher, Colin Kelly Junior High School, Eugene; Charles Peter, principal, Leslie Middle School, Salem; and Ray Talbert, Research, Assessment, and Evaluation, Oregon Department of Education.

These five committee members first read and scored the ten applications independently, then met as a group to settle upon Oregon's two finalists. Charles Peter, selection committee member, remembers it as "a frustrating process because all the award applicants were so very outstanding."

Applications of Oregon's two finalists, Board and McGraw, were sent to Washington, D.C., for consideration by the twelve-member National Presidential Awards selection committee in August. Most committee members represented private foundations, ivy league universities, and state departments of education. Wally Rogelstad, mathematics teacher at Rex Putnam High School in Milwaukie, was one of only two teachers on the national committee. (Serving on this selection panel was Rogelstad's valid reason for not applying for the award himself.)

Rogelstad explains that the national selection process closely mirrored that followed by Oregon's committee. Six of the twelve committee members screened and deliberated over candidates for the mathematics awards, while the other six judged science teacher finalists. He, himself, read and scored 52 applications of mathematics

teachers from the eastern half of the country, but he watched with keen interest as others deliberated over western state finalists. Rogelstad reports that McGraw and Board were both rated so uniformly highly by national panelists that they would have preferred to name both as Oregon's award winner.

Fred Board
Westridge Middle School
Oakridge School District

Fred Board gets an early start every teaching day at Westridge Middle School. Bruce Hemm, principal of this fifth, sixth, and seventh-grade middle school in Westfir, five miles out of Oakridge, explains, "Fred never arrives later than 7:30 a.m. even though school doesn't start until 8:30. He's always ready to meet the day's challenges."

Besides starting each day thoroughly prepared for his teaching, Board comes full of energy and enthusiasm for the day's instructional activities. Neither his enthusiasm nor his energy seem to flag during the day. His manner remains uniformly calm and unruffled whether he's teaching problem-solving strategies, helping a student debug a computer program, counseling a disruptive student, or administering first aid to a noontime recess casualty.

Besides enthusiasm for mathematics, Board and his students share a mutual esteem for one another as capable human beings. An atmosphere of respect pervades each of Board's math classes. This teacher does not give his students the impression that he is the only one with right answers. He patiently listens, waits, and leads all students to think and try problems and activities. No student is deprecated for an incorrect response or interpretation. Instead, Board encourages and may even apply his gentle sense of humor if he knows a student simply did not pay close attention to detail. Board believes every student has worthwhile ideas. This belief clearly shows through and is reciprocated

by his students.

Fred Board's Approach to Instruction

Board immediately immerses his seventh-grade students in mathematics as soon as they take their places in his classroom. Handing out cards bearing numbers and questions, Board queries, "Who has fourteen?" The student with card fourteen quickly responds, "I have fourteen," and continues with the question on the card, "Who has that times three?" The student in the room with forty-two responds, then asks, "Who has that divided by seven?" And so it goes, with students listening and responding in rapid fire fashion--for Board is timing them. When they return to fourteen, or whatever number initiated the day's chain reaction, Board records their time on the chalkboard and compares it to their previous best.

This exercise helps students keep basic number facts well in mind and sharpens their "mental math" skills as well as sets the tone for each class, a tone of involvement. Students remain involved and attentive throughout classtime because Board engages them in interesting activities, speaks with a clear, commanding voice, and does not repeat instructions. Students are aware that they must listen carefully or they will miss out on some of the day's activity. As seventh-grader Bridgette Dever explains, "Mr. Board makes us learn. He takes us step by step and makes <u>us</u> remember. He doesn't <u>give</u> us answers. We have to learn and remember how to do things ourselves."

Bobby Jo McPherson, another seventh-grade mathematician, adds, "He doesn't waste his breath."

Not only are his students attentive to him, but Board is well aware

of each student's level of ability and progress. He adjusts his instructional approach accordingly. Board explains that every student is different. When he encounters a student who is highly frustrated because of learning problems, he searches until he finds some activity at which the student can have initial success. He believes that the student's frustration cannot be overcome until he experiences some measure of success whether it be with a calculator, at a computer, or in a class activity.

Ruby Richardson, another Westridge seventh-grader and a student new to Oregon schools this year, believes that Fred Board is different from other mathematics teachers she has had because "he gets us started with solving problems by teaching us a little at a time. He then builds upon what he's already taught us. He doesn't just give us problems to do and expect us to understand how to work them on our own."

Board ensures that each day's classes are activity-oriented in order to maximize student involvement and learning. He has manufactured most of the manipulative materials he uses with students. Board feels fortunate to teach in Oregon where there are so many good mathematics teachers who generously share their ideas and approaches at state and regional conferences. Besides the varied ideas available via conferences, Board explains that Oregon teachers also have access to Math Resources Project (MRP) materials that were developed with National Science Foundation funding in the mid-1970s at the University of Oregon by public school and college mathematics educators. In addition to these extensive MRP materials, Problem Solving in Mathematics Project (PSM) materials developed in the late 1970s by teachers under the

direction of Oscar Schaaf through the Lane County ESD are another invaluable aid to Board's activity-oriented teaching. (OSSC Bulletin, Vol. 24, No. 6, details the Problem Solving in Mathematics Project's development and materials.)

Microcomputers form an integral part of Board's program of instruction. (Oakridge teachers' approach to computers in education was the subject of another OSSC Bulletin, Vol. 25, No. 8. Readers may refer to this earlier publication for more detailed reporting about Fred Board's instruction with microcomputers.) Students are eager to use them in both morning mathematics classes and afternoon computer classes. In fact, they are even willing to forego noon recesses in order to make up any class assignments they may miss while working at the computers. Others plead with Mr. Board to use the microcomputer at noon break. He yields to these requests, as well as to students' pleas to play math games in his room at noon. Most every noontime brings a full house of students to Board and his classroom.

Westridge teachers and Oakridge School District administrators applaud Board and his instructional program and are pleased to see him recognized for his accomplishments. Nancy Henry, a fellow teacher at Westridge, volunteers, "Fred is a great teacher and we're so proud of him. We've all learned a great deal from him."

Dr. Ken Carver, Oakridge superintendent, explains, "Fred epitomizes what a master teacher should be. But he is so humble. You have to drag his accomplishments out of him."

Bruce Hemm, Westridge principal, attributes Board's success as a teacher to his honesty with students, parents, and staff, to his

organizational abilities, and to his involvement in the classroom as well as beyond.

Fred Board's Contributions beyond the Classroom

As Hemm explains, "Fred works with students on all levels of the school program." He has coached boys' and girls' basketball, softball, and track in addition to serving stints as timer, scorekeeper, referee, and umpire at school and summer athletic events. He has also been an active adviser to student government groups.

Board has been instrumental in the development of Westridge's outdoor education program, which serves as an extension of the regular classroom curriculum. He has incorporated a great deal of applied mathematics activities into the outdoor program and intends to extend them when more of the land around the school is developed. As additional species of trees are planted on the school grounds, students will be able to measure them, plot their growth and survival rates, and compare productivity of open versus shaded plots.

To further emphasize practical applications of mathematical processes, Board and his wife Jill, a second grade teacher at Oakridge Elementary School, have created a twenty minute multimedia slide show utilizing four projectors, three screens, and musical accompaniment. It focuses upon kindergarten through high school students involved in mathematics activities and has been shown to parent and community groups and at state and regional math conferences.

Board, who has taught Oakridge youngsters for twenty years, also teaches evening computer classes for school district staff and community members. Those who enroll can earn credit for their work through either

Lane Community College or Portland State University. These classes are always filled to capacity. In fact, next term's class is filled already, and a waiting list is being formed for a third class yet this school year.

Fred Board's involvement in mathematics education extends well beyond Oakridge School District boundaries. He has helped plan and is a frequent presenter at state and regional mathematics conferences and has put on workshops for numerous Oregon school districts. He facilitated instructional materials development in Oregon by field testing Math Resource Project materials and piloting Problem Solving in Mathematics Project lessons. He is also a frequent contributor to the The Oregon Mathematics Teacher, the OCTM professional journal.

Board's key to keeping current with developments in mathematics education and to constantly replenishing his store of teaching strategies is ongoing education for himself through continuous interaction with other teachers by means of membership in professional organizations. But he has not been content to merely sit back and receive the benefits of membership. He also gives. He served from 1979 to 1981 as president of Oregon Council of Teachers of Mathematics, the active statewide organization of some 1,200 elementary, secondary, and higher education mathematics teachers.

The OCTM president coordinates state activities and meetings plus works closely with representatives from each of ten OCTM regions in which the state is divided to ensure that regional events go well. Much of the planning for each year's activities occurs at the summer Math Leaders Conference cosponsored by the Oregon Department of Education and

OCTM. Here Don Fineran, OCTM officers and regional representatives, and other mathematics teachers, who have been noted and invited for their potential leadership, plan and set the annual agenda for professional mathematics education activities in Oregon.

Sue McGraw
Lake Oswego High School
Lake Oswego School District

Service to and involvement in Oregon mathematics education set Sue McGraw apart just as they do Fred Board. She followed Fred as president of OCTM, serving from 1981 to 1983. She has regularly attended, helped plan, and made presentations at state and regional conferences since she started her teaching career in La Grande fifteen years ago. Currently she serves on a state level committee appointed by State Superintendent Duncan to develop a comprehensive plan to strengthen mathematics and science instruction and learning throughout the state.

Recently she had the opportunity to contribute to a similar national effort during her trip to Washington, D.C., in October. Of course, the focal point of her stay in the capital was the Presidential Awards for Excellence ceremony with President Reagan and Secretary of Education Bell in the East Room of the White House. Two special receptions for awardees that McGraw describes as "elegant" were also memorable. But of special importance to her were opportunites to talk with officers and directors of NCTM and NSF and to interact with fellow mathematics and science teachers in a working conference at the National Academy of Sciences. Here they debated questions such as: What should be the future direction for NSF in mathematics and science curriculum development efforts? How can excellence in teaching be fostered? What can agencies such as NSF do to promote excellence? Ideas and conclusions that came out of these discussions will soon appear in an NSF report.

McGraw is scheduled to continue her contribution to efforts to strengthen mathematics teaching nationwide at a meeting in Indianapolis in December. The National Forum on Excellence in Education, December 6-8, culminating the twelve regional forums designed to disseminate the report and recommendations of the National Commission on Excellence in Education, should provide further opportunity for McGraw to share her insights and ideas for improving mathematics instruction in U.S. schools.

Sue McGraw's Contributions to Mathematics Education in Oregon

McGraw's participation in development and dissemination of materials and techniques for mathematics educators got its start back in 1973 when she took part in a summer workshop at the University of Oregon. This summer session was designed for mathematics teachers of educationally uninvolved students and it introduced her to a wealth of fascinating ideas and materials totally new to her. She helped organize and lead similar workshops for other teachers in Salem and at home in La Grande the next two summers.

Based upon McGraw's and other teachers' recommendations that these effective techniques deserved wider dissemination among Oregon teachers, University of Oregon mathematics educators initiated the Mathematics Resources Project. McGraw participated in its development by working as a research assistant at the university from 1975 to 1977 writing classroom activities for the four-volume resource for middle school teachers.

Soon after she returned to public school teaching--this time in the

Portland area--she took on the editorship of The Oregon Mathematics Teacher, the 40-page professional journal of the OCTM. Serving in this capacity while teaching full time, she spent evenings and weekends soliciting and editing articles, designing layouts, arranging for printing, and ensuring that eight issues a year reached subscribers from 1978 to 1981. According to Mike Shaughnessy, mathematics professor at Oregon State University, "The Oregon Mathematics Teacher is second in quality to no other state math journal in the country due to the efforts of enthusiastic and dedicated workers like Sue McGraw."

A further contribution McGraw has made to improving mathematics instruction in Oregon schools and one that has been especially exciting to her has been her work with elementary teachers. As a part-time instructor for Portland State University, she has taught several evening mathematics methods classes. "Interaction with elementary teachers has greatly broadened my background and understanding," she explains. In turn, she feels that she created in them "a love for mathematics, a sense of what mathematics is, and how to teach mathematics in a problem-solving approach to young children."

Besides elementary methods classes, McGraw has taught college algebra and calculus, probability and statistics for middle school teachers, and mathematics methods for secondary teachers at Portland State.

McGraw believes that mathematics educators in Oregon are fortunate, not only because they have so many good ideas and resources to share, but because communication among all levels of mathematics educators is so open. State department, public elementary and secondary school, and

college and university mathematics educators communicate and meet together frequently and regularly.

She credits the supportive, cooperative atmosphere that exists within Lake Oswego High School's mathematics department to similar open communication channels among the seven full-time and three part-time mathematics instructors. McGraw explains, "We are supportive of each other and are constantly aware of what each other is doing. Of course, we have many fine students, but the caring and respect we share as a staff certainly makes this an exceptionally nice place to teach."

Sue McGraw, Classroom Teacher

Clear explanations, dependability, and a thoughtful, helping attitude are qualities that McGraw's students point to when explaining why she is so effective as a teacher. Lake Oswego High School senior calculus student Lisa Zindel says, "If Miss McGraw says she'll help you at a certain time, she's there." Calculus classmate Chris Staff tells that McGraw does not just present information to students; she's there to help. Ninth-grade basic math student Jack Phillips believes the key to McGraw's success as a teacher is due to her patience. "She takes time with us and gives us time to figure things out. She explains things so we can understand," he specifies.

Dave Thompson, a senior in McGraw's Computer Science I class, sums up the sentiments of many students: "They made a good choice in giving Miss McGraw the award. She teaches you in a step-by-step and personalized way. It's kind of like a friend showing you how to do something, but, at the same time, everybody has a lot of respect for her."

Besides calculus and beginning computer science, McGraw teaches geometry and basic math classes and serves as Lake Oswego High School's mathematics department chair. This means that, in addition to teaching, her duties include budgeting, planning, scheduling, and evaluating. McGraw also serves as head junior class advisor, helping coordinate fund-raising activities for the junior-senior prom.

During computer science and basic math periods her students are at task working at their own pace at learning activities. She devotes her time to patiently helping individual students with their work. Calmly moving from student to student, McGraw sees that all receive the assistance they need by making abstract concepts more concrete through examples relevant to them and by jokingly coaxing reluctant learners to focus upon their work.

She demonstrates an enthusiasm for mathematics and a devotion to transmitting an understanding of it to her students. She regards no student's question as trivial nor any mistake as laughable. Each merits her undivided attention. But rather than merely answering questions and correcting mistakes, McGraw stimulates students to illustrate or explain their own problems using appropriate mathematics terminology.

Although her geometry and calculus classes are more lecture-oriented and teacher-directed, McGraw still strives in these sessions to involve students in the discussion of mathematics concepts. She believes that they will more clearly understand abstract ideas if they can express them orally. She consciously and constantly models such expression by incorporating appropriate mathematical terms and explanations into conversations with students as well as into lectures.

McGraw makes clear that she sees mathematics as an integrated process, not merely the isolated manipulation of symbols. John Turchi, Lake Oswego High assistant principal, emphasizes that she has been a leader in the district by insisting upon the development in students of deeper understandings and problem-solving abilities.

Turchi attributes McGraw's effectiveness as a teacher to "her infectious enthusiasm for what she does, her clear understanding of her subject area and the ability to communicate it well, and her hard work." He concludes, "She knows her students as people and cares about them as individuals. They know that, too."

Conclusion

Sue McGraw and Fred Board are effective teachers, with their own unique, individual classroom styles. But they possess many common characteristics that seem integral to their effectiveness as teachers. Both their classrooms are filled with an atmosphere of reciprocal respect between teacher and students. Both are easily approached by students and readily respond to their needs. Students of both teachers emphasize their ability to make mathematical concepts clear through step-by-step teaching and practice activities. They also point out that these teachers ensure that students understand basic ideas before they move on to more complex ones.

Besides actively participating in professional organizations and volunteering untold hours to the cause of mathematics education in Oregon, these teachers continuously update their own professional training. And, when pressed to talk about their own accomplishments McGraw and Board tell of all the other outstanding, devoted mathematics educators and mathematics education opportunities available in this state.

They are probably most alike, though, in the two "loves" that they share: students and mathematics.

Appendix A

1983 Presidential Awards for Excellence in Science and Mathematics Teaching

ELIGIBILITY AND CRITERIA FOR NOMINATIONS

I. Eligibility

A. Full-time classroom teacher of science or mathematics at grade level 7 to 12 in a state accredited school or an accredited school in Washington, D.C. or Puerto Rico.

B. A minimum of five (5) years teaching in science or mathematics.

II. Criteria for Nomination

A. Classroom Performance and Effect on Students

The teacher-nominees:

1. over a period of years have successfully taught science or mathematics to a broad spectrum of students.

2. have attained a reputation among peers for reaching all students while encouraging the attainment of excellence.

3. should produce supporting evidence from students, parents, and/or peers that they have significantly improved students' understanding of (or competence in) mathematics or science.

B. Personal and Professional Goals

The teacher-nominees should:

1. have displayed goals that extend beyond preparing students for the next course and the next academic year.

2. have a strong content foundation in the subject matter taught.

3. show evidence of continued interest and growth in their subject matter area and in the mechanics and artistry of teaching.

4. show evidence of involvement, at least at the local level, in the professional responsibilities of their discipline.

Source: Letter soliciting applications from nominees for Presidential Awards for Excellence, James D. Gates, National Council of Teachers of Mathematics, Executive Director.

Appendix B

NOMINEE'S QUESTIONNAIRE

Use separate sheets of paper to answer the following questions or to provide the information called for:

1. Background and Experience

   a. Formal Education. Give postsecondary programs resulting, or intended to result, in a degree. Give the institution, location, type of degree, and major dates in which the degree was granted. (If program is not yet completed, list courses completed to date.)

   b. Continuing Education Activities. Give the dates taken, institution, and nature of activity or course. Include anything that would fall appropriately under the heading of staff development or personal development and that would result, directly or indirectly, in your being a more effective teacher.

   c. Teaching Experience. Give the school, teaching assignment, dates, and any other related information you feel would give a more vivid picture of your teaching career. (Include employment other than teaching.)

   d. Professional Activities.

   e. Community Involvement.

   f. Special Youth Activities.

   g. Special Hobbies, Travel, Research Interests, Work in Industry, etc.

2. Identify a critical problem that affects the teaching of science or mathematics in your school district and discuss what might be done about this problem.
   (2 pages, typed, double-spaced)

3. Which of your accomplishments as a teacher within the last three or four years do you find most gratifying? Identify and discuss.
   (1 page, double-spaced)

4. Under the National Science Foundation plan approved by Congress, an award of $5,000 will be make to each awardee's school to supplement, not replace, other resources for use in improving the science or mathematics program, under the direction of the awardee teacher. If you were selected for a Presidential Award, how would you propose that the money be used?
(1 page, double-spaced)

5. Append a maximum of four letters of support (each one page only) Such letters are optional. Letters may be from colleagues, students or former students, a supervisor/administrator, or parents of a present or former student.

Source: Letter soliciting applications from nominees for Presidential Awards for Excellence, James D. Gates, National Council of Teachers of Mathematics, Executive Director.

Interviews

Fred Board, mathematics teacher, Westridge Middle School, Oakridge School District, interview, November 3, 1983.

Dr. William Burger, professor of mathematics, Oregon State University, interview, November 7, 1983.

Dr. Ken Carver, superintendent, Oakridge School District, Oakridge, interview, November 3, 1983.

Bridgette Dever, student, Westridge Middle School, Oakridge School District, interview, November 3, 1983.

Don Fineran, specialist in mathematics education, Oregon Department of Education, Salem, interviews, September 15, October 28, 1983.

Bruce Hemm, principal, Westridge Middle School, Oakridge School District, interview, November 3, 1983.

Sue McGraw, mathematics teacher and department chair, Lake Oswego High School, Lake Oswego School District, interview, November 8, 1983.

Bobby Jo McPherson, student, Westridge Middle School, Oakridge School District, interview, November 3, 1983.

Charles Peter, principal, Leslie Middle School, Salem School District, interview November 7, 1983.

Jack Phillips, student, Lake Oswego High School, Lake Oswego School District, interview, November 8, 1983.

Ruby Richardson, student, Westridge Middle School, Oakridge School District, interview, November 3, 1983.

Dr. Michael Shaughnessy, professor of mathematics, Oregon State University, interview, November 5, 1983.

Chris Staff, student, Lake Oswego High School, Lake Oswego School District, interview, November 8, 1983.

Dave Thompson, student, Lake Oswego High School, Lake Oswego School District, interview, November 8, 1983.

John Turchi, assistant principal, Lake Oswego High School, Lake Oswego School District, interview, November 8, 1983.

Lisa Zindel, student, Lake Oswego High School, Lake Oswego School District, interview, November 8, 1983.

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